

UK Patent Application GB 2 189 164 A

(43) Application published 21 Oct 1987

(21) Application No 8606351

(22) Date of filing 14 Mar 1986

(71) Applicant

University of Birmingham

(Incorporated in United Kingdom)

P.O. Box 363, Edgbaston, Birmingham B15 2TT

(72) Inventor

Colin Raymond Bernrose

(74) Agent and/or Address for Service

Marks & Clerk,

Alpha Tower, Suffolk Street Queensway, Birmingham
B1 1TT

(51) INT CL⁴

B01J 8/36 8/24

(52) Domestic classification (Edition I):

B1F 111 115 311 611 915 931 CF

(56) Documents cited

GB A 2143148

GB A 2036274

GB 1166675

GB A 2126916

GB 1604999

EP 0154717

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(58) Field of search

B1F

Selected US specifications from IPC sub-class B01J

(54) Apparatus for fluidised beds

(57) A fluidised bed combustor comprises a container 10 for particulate material 12 which lies over a porous base 11 through which air can flow from a supply passage 14 and a chamber 13. A classifier outlet has an opening 18 in a zone of the base 11 towards which surrounding material tends to move as a result of increased circulation of the particulate material 12 in that zone. The increased circulation may be provided by increasing the air pressure in a part of the chamber 13 adjacent that zone or by inclining the base 11 to the horizontal.

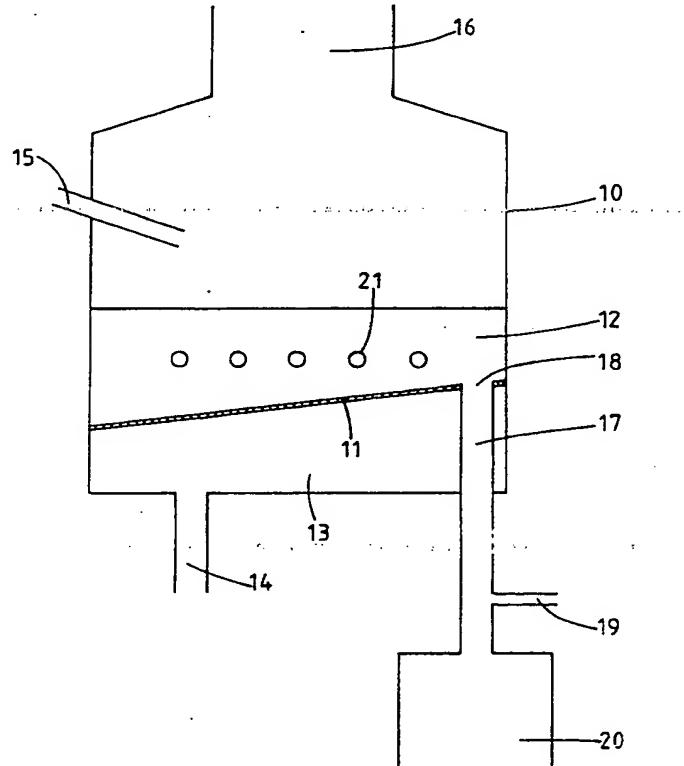


FIG. 1.

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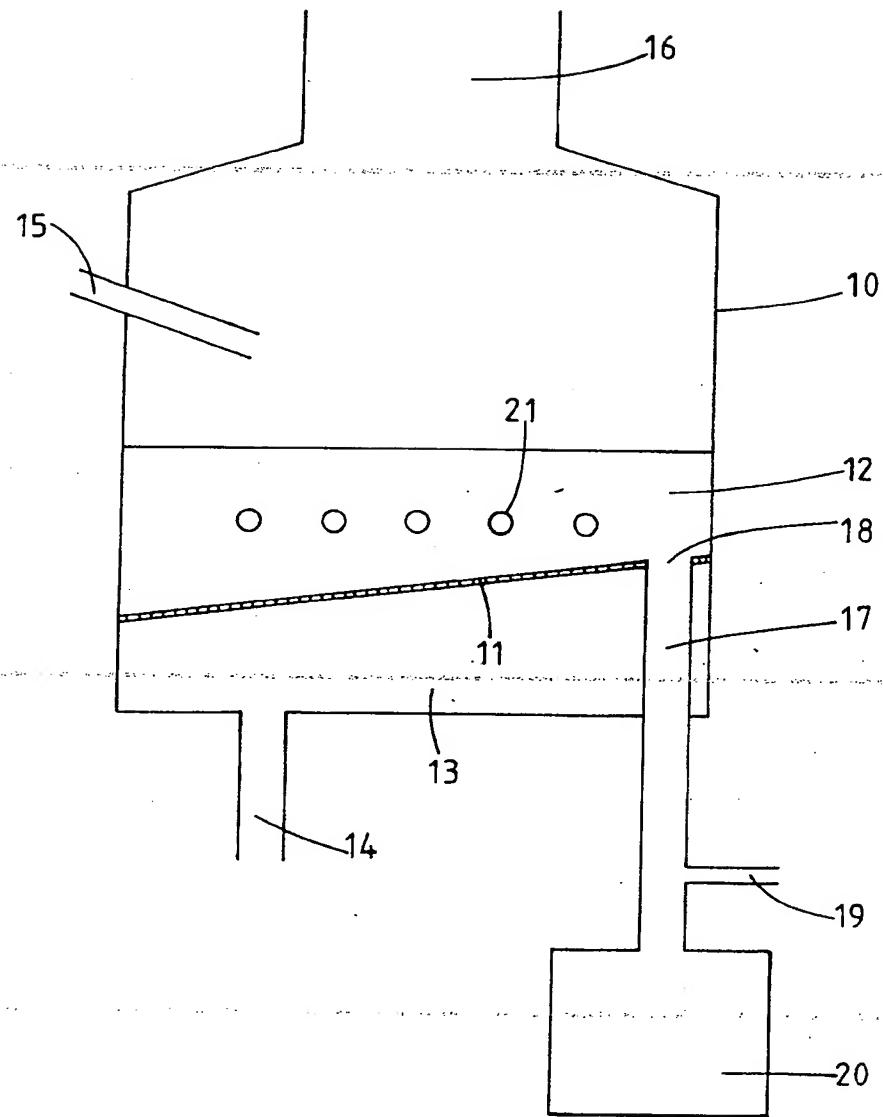


FIG. 1.

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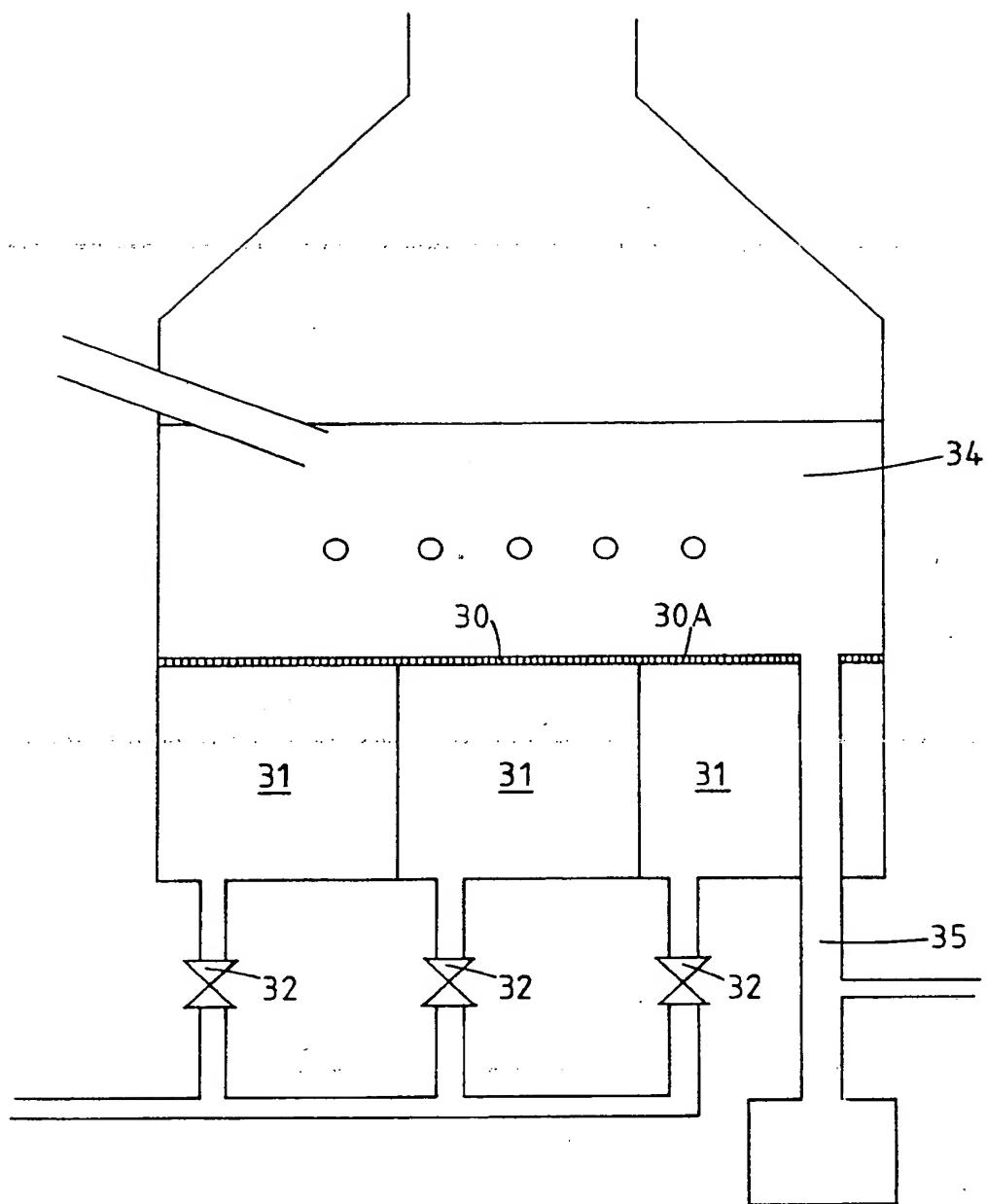


FIG.2.

SPECIFICATION

Apparatus for fluidised beds

- 5 This invention relates to apparatus for providing a fluidised bed, that is to a bed of particles which can be fluidised by a gas admitted to the base of the bed and in which physical or chemical reaction occurs in elements supported by the bed. In particular the invention relates to apparatus in which solid fuel masses are supported in the bed for combustion.

In such apparatus problems arise from collection at the bottom of the bed of solid residues which may be present in the reactants or arise from the reaction process. Particularly, in known fluidised bed combustors the incombustible residues of a solid fuel supply must be kept to relatively small sizes, of the order of 120 mm³. It is also necessary that such residues shall be continuously removable from the bed without interruption of its operation. If relatively larger pieces of incombustible material, of the order of 8000 mm³ or larger can be removed from the bed this will have the effect that a fluidised bed combustor could work satisfactorily with solid fuel having a larger percentage, e.g. 20–30%, of incombustible material than has hitherto been considered acceptable, and without pre-crushing that fuel to the small pieces previously required.

It is an object of the invention to provide a fluidised bed apparatus in which the foregoing problems are substantially overcome.

According to the invention an apparatus operable to provide a fluidised bed comprises a container, a mass of particulate material with said container, a base through which a fluidising gas flow can be introduced into said material, means for effecting a local increase in the rate of circulation of said material at a zone thereof adjacent said base, and a classifier outlet at a location in said base portion adjacent said zone.

In a particular embodiment said means for effecting said circulation increase comprises at least a portion of said base inclined to the horizontal.

50 In a further particular embodiment said classifier outlet is located adjacent the highest part of said base portion.

In an alternative embodiment said means for effecting circulation increase comprises means for providing a higher gas flow through said base into said zone of the material than into the remainder of said material.

Examples of the invention as applied to a fluidised bed combustor will now be described 60 by way of example and with reference to the accompanying drawings in which:

Figure 1 is a diagram of a fluidised bed combustor having a base inclined to the horizontal, and

65 Figure 2 is a diagram of a fluidised bed

combustor having means for providing differing gas flows to different locations of its base.

Fig. 1 shows a container 10 having a base plate 11 which is inclined to the horizontal. A bed 12 of refractory particulate material, for example sand, is supported on the base plate 11 which is perforated to allow flow of pressurised air from a lower chamber 13 of the container into the bed 12, to effect fluidisation thereof. Pressurised air is introduced into the chamber 13 through a supply passage 14. A supply conduit 15 for solid fuel opens into the container 10 above the bed 12. A flue 16 for combustion products extends upwardly from the top of the container 10. A classifier outlet passage 17 extends downwardly through the chamber 13 and communicates with an opening 18 in an upper part of the base plate 11. The passage 17 and opening 18 have a diameter such as to allow the largest anticipated masses of incombustible residue to pass readily downwards. Air is supplied to the passage 17 through a pipe 19 at a pressure such that upward velocity of air in the passage 17 exceeds the terminal velocity of falling sand grains from the bed 12, but permits larger masses to drop through the passage 17 to a suitable collector 20. The combustor may include heat exchanger tubes 21 which pass through the container 10 either within the bed 12 or above it, or both.

In use solid fuel introduced through the conduit 15 burns while suspended within the bed 12, combustion air being provided by the fluidising air flowing through the base plate 11. It has been found that incombustible residues, for example shale, resting on the plate 11 move thereover towards zones which are determined by the inclination of the plate 11 and the flow patterns within the bed 12. Classifier outlet passages 17 are located so as to open through the plate 11 at the or each of the zones. In a particular example it has been found that incombustible masses move upwardly across the plate 11 to a zone adjacent the highest part thereof and in the present example, the opening 18 is shown located accordingly. The mechanism of this movement is considered to be that in shallower areas of the bed 12 air flowing through the plate 11 tends more readily to coalesce into bubbles, resulting in increased upward movement of the bed particles by those bubbles. Bed particles move to occupy the spaces left by that upward movement, the effect being that adjacent the base plate 11 there is a movement of the bed particles towards the higher end of the plate 11. This movement carries with it any masses resting on the plate 11. It will be understood that the plate 11 may be formed so as to provide a plurality of surfaces some or all of which are inclined to the horizontal, a classifier outlet being located at a zone of each of the aforesaid inclined planes

to which incombustible masses tend to move. It will also be understood that by temporary reduction or removal of an air supply through the pipe 19 a quantity of sand from the bed 5 12 may be allowed to pass into the collector 20, from which it may be withdrawn for cleaning and reintroduction into the bed 12, for example through a conduit similar to the conduit 15, or by other suitable means.

10 In alternative embodiments the conduit 15 may open directly into the bed 12 and the plate 11 be substituted for by a porous ceramic or metal tile, by standpipes which extend upwardly for a short distance above the plate 15 11 or by an apertured tube or sparge pipe assembly within the bed 12 adjacent the plate 11.

Fig. 2 shows a fluidised bed combustor which is generally similar to that shown in Fig. 20 1 but which has a horizontal base plate 30 and a plurality of plenum chambers 31 through which air is supplied to different sections of the plate 30. Air pressure in the respective chambers 31, and hence airflow 25 through corresponding sections of the plate 30 can be selectively controlled by valves 32. In the example shown the pressure in the right hand chamber 31 is controlled to be the highest. Air within the bed 34 above the right 30 hand portion 30A of the plate 31 will have a higher flow rate than that of adjacent portions of the bed 34 and tend to coalesce into bubbles, with the circulatory effect described above with reference to Fig. 1. Masses resting 35 on the plate 30 are thus urged to the portion 30A thereof and a classifier outlet 35, identical with the outlet 17 of Fig. 1, opens through the plate 30 at that location.

40 CLAIMS

1. An apparatus operable to provide a fluidised bed, comprising a container, a mass of particulate material within said container, a base through which a fluidising gas flow can 45 be introduced into said material, means for effecting a local increase in the rate of circulation of said material at a zone thereof adjacent said base, and a classifier outlet at a location in said base portion adjacent said zone.
- 50 2. An apparatus as claimed in Claim 1 in which said means for effecting a local circulation increase in the particulate material comprises means for providing a higher gas flow through said base into said zone than into the 55 remainder of said material.
3. An apparatus as claimed in Claim 1 in which said means for effecting a local circulation increase in the particulate material comprises at least a portion of said base being 60 inclined to the horizontal.
4. An apparatus as claimed in Claim 3 in which said classifier outlet is located adjacent the higher part of said base portion.
5. An apparatus as claimed in Claim 4 65 which includes a plurality of portions of said

base inclined to the horizontal and a plurality of classifier outlets located adjacent the highest parts of respective ones of said portions.

6. An apparatus as claimed in any preceding claim which includes means for supplying fuel to said container.
7. A method of removing unwanted material from the base of a fluidised bed having a classifier outlet opening into said base, comprising locally increasing the circulation of bed material at a zone thereof adjacent the opening of said classifier outlet.
8. A method as claimed in Claim 8 in which local increase in circulation of the bed 80 material is effected by providing a higher gas flow into said zone than into the remainder of the bed material.
9. An apparatus operable to provide a fluidised bed, substantially as hereinbefore described with reference to Fig. 1 or Fig. 2 of the accompanying drawings.
10. A method of removing unwanted material from the base of a fluidised bed, substantially as hereinbefore described with reference to Fig. 1 or Fig. 2 of the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd, Dd 8991685, 1987.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.

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